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ELEVENTH GENERAL ASSEMBLY OF THE INTERNATIONAL ASTRONOMICAL UNION, BERKELEY, CALIFORNIA, AUGUST 15–24, 1961

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The second General Assembly of the International Astronomical Union to be held in the United States more than lived up to the traditions previously established among the astronomical fraternity of the world for mutual discussions of current astronomical problems in an atmosphere of international co-operation and friendly competition. Under the leadership of President J. H. Oort of the Netherlands, and the general direction of Secretary D. H. Sadler of Great Britain, members of the Union were fully occupied during ten days of intense activity. Much of the time was spent in Commission meetings where astronomers in each of 36 fields reviewed the achievements of the past three years and discussed plans for the future but, in addition, there were two business sessions, three invited discourses, three joint discussions and, on the lighter side, formal and informal receptions and get-togethers, concerts, and trips in and around the San Francisco Bay area.

The International Astronomical Union has been officially active since 1919 when, at the end of the First World War, several international unions were formed by the International Research Council. The organizational meeting was held in Brussels and the first General Assembly met in 1922 in Rome under the leadership of Dr. B. Baillaud of France. There the statutes of the Union were passed and it was declared that the purposes of the Union are (i) to facilitate the relations between astronomers of different countries where international co-operation is necessary or useful; and (ii) to promote the study of astronomy in all its departments. Any country where independent astronomical activity has been

developed may adhere to the Union. Canada joined the Union in 1920. The adhering body is the Observatories Branch of the Department of Mines and Technical Surveys, but recommendations for membership in the Union and other policy decisions are proposed to it by the National Committee—a body of twenty-two members appointed by the Dominion Department, by the Royal Society of Canada, and by the Royal Astronomical Society of Canada plus additional elected representatives.

The character of the General Assemblies has certainly changed since those first held in Rome, Cambridge, Leiden and Cambridge, Mass. In the beginning, two hundred or fewer members attended the Assemblies and at the small commission meetings, most members knew each other personally and it was possible to discuss future programmes informally. At Berkeley it has been reported that 947 members and guests of the I.A.U. from 36 countries took part in the convention. Nearly half of the participants came from the United States; nearly one hundred came from Great Britain, and France, Germany and the U.S.S.R. each were represented by fifty or more delegates. There were twenty-nine delegates from Canada, eleven of whom were accompanied by their wives. As a result of the large attendance and the increase in the number of Commission meetings, many of which overlapped in time, it was impossible to meet everyone, even all of those working in one's own field, and it was certainly impossible to attend all the meetings of commissions dealing with subjects in which one was interested. However, the general consensus of opinion remains that it is most desirable for astronomers to meet together every three years in order to participate in the formal discussions and, even more important, to spend a few days living with other workers whose interests correspond, for such direct contact is bound to be inspiring and profitable.

The General Assembly was formally opened on the morning of August 15th in the large Plaza at Dwinelle Hall of the University of California where a crowd of some ten thousand people had gathered to hear Dr. Leo Goldberg, chairman of the U.S. National Committee, read a telegram of greetings from the President of the United States, as well as addresses by President J. H. Oort and the U.S. Ambassador to the United Nations, Adlai E. Stevenson. Dr. Oort commented especially on the rapid growth of both optical and radio astronomy and wondered whether the unwieldy size of the gatherings might not require some modification of the structure of the Union although "for the present we still have all subjects of astronomy united and we must enjoy this meeting to its fullest extent . . . now that we have come together in a state named after a fabulous island . . . as being near to paradise and which, for astronomers, is paradise." Ambassador Stevenson, in his address which was partly

political in character, commented on "the unity and purity of purpose of the pursuit of truth about the universe . . . Scientifically and technically the world has become a single community yet . . . we, the governments and citizens are lagging dangerously far behind you, the scientists. . . . As certainly as oceans were conquered in the century of Columbus and Magellan, new realms of space will be conquered in this century. . . . At this fateful moment in history when man has, so to speak, one foot already in the heavens, surely we must find ways for the powers to co-operate rather than fight in their exploration of outer space, . . . one of the greatest adventures of the whole human race."

Two business sessions of the General Assembly were held, the first on the afternoon of the opening ceremonies and the second to end the conference officially. In a change in organization, the Commissions, representing the many fields of astronomy, were strengthened by the appointment of vice-presidents and organizing committees to look after the development of each field, whereas formerly the president was responsible for most of the activity between assemblies. Members of the Union may belong to, at most, three commissions. The growth of the field concerned with the computation of numerical analogues to stellar atmospheres was recognized by making the former Sub-Commission "Stellar Atmospheres" a full Commission while other Sub-Commissions were either disbanded or became working committees within the appropriate commissions. The only formal vote required during the Assembly concerned the decision of the Executive Committee to admit Taiwan as an adhering country. The Czechoslovakian Academy of Sciences and the U.S.S.R. Academy of Sciences submitted resolutions that this decision be revoked, and the People's Republic of China had notified the I.A.U. that, as a result of this decision, it would resign its membership. However, the vote by countries upheld the executive decision. At the final session of the Assembly two resolutions were presented concerning the U.S. Project West Ford—a proposal that one or more belts of thin microwave dipoles, i.e. needles of copper, be placed in orbit at an altitude of a few thousand kilometres above the earth in order to test the possibilities of obtaining a reliable system of long-range radio communication. The first resolution stated that "viewing with great concern the grave danger that future space projects might seriously interfere with both optical and radio astronomical observations, and believing that . . . such contamination might . . . be disastrous to future observations with improved techniques, and maintaining that no group has the right to change the earth's environment without full international study and agreement, the I.A.U. gives clear warning of the grave moral and material consequences which could stem from a disregard of the future of astro-

nomical progress, and appeals to all Governments . . . to consult with the I.A.U. before undertaking such experiments and to refrain from launching until it is established beyond doubt that no damage will be done to astronomical research." In the second resolution, appreciation was expressed that plans for Project West Ford had been announced publicly before launching, but ". . . the I.A.U. is completely opposed to the experiment until the question of the permanence of the dipoles is settled . . ." and urges "that a group of astronomers . . . be permitted to co-operate with the West Ford authorities in performing quantitative experiments to determine the properties of the proposed belt of dipoles, its changes with time and location and its impact on present and future astronomical research." Both resolutions were passed unanimously by the General Assembly.

At this second meeting, Prof. O. Heckmann invited the I.A.U. to hold its XIIth General Assembly in Hamburg, Germany, in 1964, and it was announced that V. A. Ambartsumian, Academician of the Academy of Sciences of the U.S.S.R. had been elected incoming President of the Union, that T. Hagihara of Japan and G. Haro of Mexico were the new Vice-Presidents (R. M. Petrie of Canada remains as one of the other four Vice-Presidents), that D. H. Sadler of Great Britain would continue for another term as General Secretary and would be assisted by J. C. Pecker of France. In his acceptance speech, Dr. Ambartsumian expressed his faith in the future of the I.A.U., commenting that the activities of the Union have been growing even in these difficult political times, and that its main aim should be to further new scientific ideas and to co-operate in international research activities and observations in all parts of the world. He noted that astronaut Titov circled the world $16\frac{1}{2}$ times at and in approximately the same time that the Russian astronomers travelled from Moscow to Berkeley. He concluded that "there will be new achievements and knowledge reported at the next meeting of the I.A.U. but new problems will undoubtedly arise as well."

As at previous Assemblies there were several Joint Discussions, arranged by commissions having an interest in the subject chosen. The topics selected were "Stellar Motions and Stellar Dynamics", "The Sun's Magnetic Field", and "The Demands Made on Celestial Mechanics in the Computation of Ephemerides". The first included papers on current programmes for proper motions and radial velocities, the nearest stars, the solar motion, galactic rotation and the accuracy of the stellar distance scale. The second heard discussions on the topology of the solar magnetic field and the 22-year cycle, the sun's magnetic field from radio observations and as related to filamentary currents, cosmic ray flares, prominences and the chromosphere. The third discussion concerned

problems of computing an ephemeris for the moon, new and refined theories of the motions of Venus, the earth and Mars, and ephemerides for the minor planets.

Special features of the Berkeley meetings were three invited discourses on problems of vital concern at the present time. J. A. Van Allen discussed the "Dynamics, Composition and Origin of the Geomagnetically Trapped Corpuscular Radiation" in the belts surrounding the earth that his group at the State University of Iowa discovered from observations obtained by geiger counters sent up in the Explorer satellites and in Sputnik III. Van Allen noted that Störmer had studied the theory of similar motions of electrically charged particles in a magnetic field in connection with his work on the aurorae fifty years ago. Of the two belts of corpuscular radiation that surround the earth, Van Allen explained that the inner one, which is relatively stable, is believed to be the result of the action of cosmic rays; the outer belt, which is affected less by the geomagnetic field, varies with solar activity and seems to be related to a plasma of ionized gas that extends outward from the sun. In the second discourse, M. Schwarzschild of Princeton University considered modern ideas concerning "Stellar Evolution" that have been developing rapidly in the past fifteen years. Nuclear, thermal and dynamical processes take part in this evolution. Nuclear processes, represented primarily by the synthesis of hydrogen to form helium by way of the carbon cycle or the proton-proton reactions provide enough energy for stars like the sun to shine for about 10^{11} years. It is thought that the age of a star can be determined by comparing its observed position on the Hertzsprung-Russell diagram with a theoretical evolution curve; if that is true, the ages of the oldest known clusters may be 15 to 25 billion years. In some Population II red giants, a thermal process called the "helium flash" has recently been discovered where more energy is produced than can escape through the outer layers of the star, and changes in its structure must take place more rapidly than even the fastest modern computing machine can carry through the calculations. The best example of a fast dynamical evolution is that of a supernova where at least the outer layers of the star are blown completely away. The third invited discourse on "Problems of Extra-Galactic Research" was given by V. A. Ambartsumian of the Bjurakan Observatory of the Armenian S.S.R. He stressed the great variety in the size of galaxies, ranging from hundreds of thousands of millions of stars to perhaps only a few hundred thousand stars. Most galaxies seem to belong to clusters of which there are two main types, spherical regular clusters where the brightest members are elliptical galaxies, and irregular groups containing many spiral galaxies. It has recently been shown that some galactic systems must be dis-

integrating and this instability may be important both in connection with clusters and for individual galaxies. In the Milky Way, neutral hydrogen is observed to be streaming outward from the galactic centre, and giant galaxies with nuclear jets have been observed. However, Dr. Ambartsumian stressed that the greatest amount of observational evidence must yet be obtained, particularly for galactic nuclei, since the whole subject of galactic research is still only forty years old.

The principal work of the General Assembly was probably completed at the many meetings of the fifty-eight Commissions and Sub-Commissions of the Union. There the results obtained during the past three years were evaluated, and future problems were discussed. These were many and varied: the conditions to be expected at future eclipses, stars most in need of photoelectric observations, and methods of computing model stellar atmospheres. Sometimes the latest results obtained with the largest telescopes were presented in brief communications—such as the evidence found by Kraft that the radial velocities of the U Geminorum stars are variable and therefore they may be a class of double stars. All the findings presented before the Commissions will be summarized and incorporated in the Transactions of the International Astronomical Union to be published in a year or two.

A very important, but little publicized, part of the gathering was the opportunity for the members to get together with others having similar interests to discuss the results of past efforts and future procedures to be followed in order to extract from the observations the maximum amount of new knowledge. These conferences were held almost continuously—at mealtimes, between meetings and during the trips that were so generously provided by the organizing committee headed by Dr. and Mrs. C. D. Shane. The trips, usually taking up a morning or an afternoon, included bus trips across the Bay Bridges and around the San Francisco downtown districts, past the Presidio, through the Golden Gate Park, up the Twin Peaks and back by way of Chinatown. Another tour went to the Muir Woods National Monument where there is a magnificent stand of redwoods. There was also a boat trip around San Francisco Bay, under the Bay Bridge, past the city and across to Sausalito by way of Alcatraz. For the ladies there were additional trips to Palo Alto and the Allied Arts buildings and a tour of representative houses in the Berkeley area.

One of the highlights of the meeting was the opportunity for most of the members to visit the Lick Observatory, twenty miles beyond San Jose. Although the road has been much improved over the one known to the "old-timers", the numerous hair-pin turns are still hair-raising, especially in the large buses that were used. The new 120-inch reflector,

plus the 36-inch refractor, the 36-inch Crossley reflector, the 20-inch Carnegie astrograph and the other pieces of auxiliary equipment, combined with the new laboratory with its new measuring machines and photoelectric equipment make Mount Hamilton one of the most important astronomical observatories in the world. The staff went out of their way to explain the operation of the equipment and the exhibits on the walls showed that the instruments had been put to good use. The enlarged spectrum of Arcturus displayed along the length of one wall was only one evidence of the results to be obtained with the coudé spectrograph of the 120-inch telescope. A sumptuous supper on the lawn behind the main building and the trip down the mountain in the gathering dusk made the day one to be long remembered.

Other highlights included the closing dinner at the Claremont Hotel, the reception, also at the Claremont, given by the University of California, and the various Embassy receptions. The whole Canadian delegation, including Canadians now residing elsewhere, were entertained one afternoon by the Canadian Consul-General O. E. Ault and Mrs. Ault at their home, near the top of one of San Francisco's numerous hills, which had an excellent view from the top floor over the whole Bay area. There were also three musical evenings prepared and presented specially for members of the I.A.U. by artists from the University of California. On the Sunday, special trips to the Napa Valley and to Carmel were provided where, in one case, the production of the California wine industry plus a sumptuous Armenian dinner were examined and sampled, and in the other, the natural beauties of the California coast were marvelled at.

Special trips, either before or after the Assembly, were arranged to the Mount Wilson and Mount Palomar Observatories, and to the Hat Creek Radio Observatory of the University of California. A special tour of Yosemite National Park was also enjoyed by a large group.

Thus members of the International Astronomical Union, many of whom also participated in other astronomical conferences during their stay in the United States, have left for their homelands well saturated with the record of astronomical achievements presented at Berkeley. They now understand even better than before why astronomy in California has been able to develop so rapidly in so many fields, having seen the excellent staffs, observatory sites and telescopes, and weather conditions. The Berkeley meetings of the International Astronomical Union more than lived up to the expectations of those who had attended previous Assemblies of the Union. They are now history, and astronomers are beginning to prepare for the XIIth General Assembly in Hamburg.

AN INTERNATIONAL SYMPOSIUM ON DOUBLE STARS

By R. M. Petrie
Dominion Astrophysical Observatory, Victoria, B.C.

On August 11 and 12 a small group of astronomers met in Berkeley, California, to discuss problems of double-star astronomy and to exchange information about double stars. The symposium took place immediately before the eleventh General Assembly of the International Astronomical Union, and was held under its auspices. This circumstance made it possible to bring together astronomers from many countries. Thirty participants attended, representing twenty-one different observatories and ten different countries.

The Union sponsors and encourages international symposia as one of the more effective ways of stimulating astronomical research and of arranging for the necessary co-operation among astronomers engaged in one specific branch. Symposia are intended to be a partial answer to the difficulties imposed by the rapid growth and diversification of astronomy which make the General Assemblies themselves far from ideal gatherings for detailed scientific discussions. Participation in the symposia is by invitation only and every effort is made to ensure that attendance is limited to those actively engaged in research. The proceedings are usually published in scientific journals and are reprinted for wide distribution. Seventeen official I.A.U. Symposia have been held to date.

The Double-Star Symposium differed from others attended by the writer in that formal papers were not a part of the programme. Several of the participants were selected to make brief prepared statements to introduce the main topics and to stimulate discussion. The symposium then took the form of a panel discussion with emphasis being placed upon current and future needs and general problems. This form of organizing the meeting caused some anxiety beforehand but, in the event, was very successful in encouraging free discussion by all participants.

The programme was divided into four parts the discussion being introduced and controlled by a chairman of each session. The divisions were:

(a) Aims and Needs,
(b) Techniques,
(c) Programmes,
(d) Summary and Recommendations.

At the first session there was a good deal of "soul searching" over the

most useful aims of the study of double stars and much discussion over present needs. Most of the participants agreed that the chief aim should be to continue the contributions which the study of double stars makes to general astronomical progress. These include: the determination of stellar masses and dimensions; the statistics of double stars, and their orbital elements; the role of double stars in theories of stellar formation and evolution; and the use of double stars as sources of data of importance to astrophysics. There was, however, a group which insisted that the study of double stars should be considered as a valuable discipline in itself and that the contributions mentioned above should be regarded merely as useful by-products. It was pointed out, in support of this view, that it is now known that double stars (including multiple stars) are at least as common as single stars. Thus in studying double stars we are in fact studying the more representative members rather than the somewhat exceptional single bodies!

All participants agreed upon the need of more astronomers to engage in observation of visual double stars and it was emphasized that young astronomers are urgently needed for this work. The situation is that present observers are unable to cope with the necessary large amount of measuring and recruits must be found. It was pointed out, also, that it is now difficult for visual double-star observers to obtain adequate time with large telescopes and that such access is vital to continued progress in this part of astronomy. The data presented at the conference showed quite unmistakably the important contributions made by double-star astronomy. It was hoped that the realization of this will result in greater activity in observing double stars and so remove the present serious menace to well-balanced astronomical progress.

The session on techniques included discussions of the filar micrometer, the double image micrometer, the interferometer, the direct photographic method, and the spectrograph, as methods of observing double stars. It was stressed again that important advances will be made when the measuring devices, especially interferometers, can be used with telescopes of largest aperture. We were shown a new development of much promise in the application of "image tubes" to the direct photography of visual binaries. The device reduces exposure times in a spectacular way—so much so that almost instantaneous "snapshots" become possible. This results in a much clearer photograph of the double star because the effects of atmospheric tremor are greatly reduced. Henceforth with the aid of image tubes it will be possible to apply the powerful photographic method to measure double stars whose components are separated by as little as one second of arc!

Some lively discussions took place during the session devoted to programmes. The problem here is not so much what to do but rather what to omit in view of the great amount of material to be studied. General programmes of measurement have been very valuable in the past and would be of great value now but cannot be undertaken. There are now about 60,000 known visual doubles and the task of measuring all of them is quite beyond the powers of the relatively few observers having access to adequate telescopes. The general acceptance of this fact by the symposium was followed by a number of proposals of programmes which should be undertaken. The chairman of the session summarized the opinions of the participants that the most desirable and practicable surveys would include:

(a) the naked-eye stars,
(b) the stars of large parallax and/or large proper motion (the nearby stars),
(c) pairs containing variable stars,
(d) pairs of astrophysical interest,
(e) surveys completed in selected small areas on the sky.

The deliberate inclusion of spectroscopists in a double star symposium was an attractive feature of the meeting. Thus astronomers using spectroscopes were able to ask the double-star astronomers to make specific observations and, in return, were able to encourage them by emphasizing the importance of their work in astrophysical applications. On the other hand the visual double-star astronomers were able to ask the spectroscopists for data on spectral types and line-of-sight velocities needed to make their orbital studies more complete. The exchanges between astronomers working in fields technically different, but scientifically closely related, were stimulating and revealing. Out of these exchanges grew a determination to create closer liaison and better coordination between different branches of double-star astronomy. Participants completed the discussion anxious to assist one another and to contribute to the advancement of our knowledge of double stars and its beneficent influence on astronomy generally.

In closing this brief account the writer hopes that the possibility of making observations of double stars may interest some non-professional readers. Many groups of amateur astronomers possess excellent telescopes and enthusiastic and skilful observers. Such groups could make a valuable and permanent contribution to astronomy by undertaking programmes of measurement of the angular separations and orientations of the components of visual double stars.

A ZENITH TELESCOPE OF HISTORICAL INTEREST

By Arthur E. Covington
National Research Council, Ottawa, Ontario

The zenith telescope shown in the accompanying photograph is of interest in the development of Canada. It was used in the 49th parallel Boundary Survey of 1872–1874 and in the Survey of the Railway belt required by the entry of the Province of British Columbia in 1871 into Confederation. The instrument has been identified from the brief account of its work in the article, "The Dominion Astronomical Observatory at Ottawa" by Otto Klotz which appeared in this Journal, vol. 13, page 1, 1919.

The basic instrument as shown in the photograph has been loaned to the Observers' Group of the Ottawa Centre from the Dominion Observatory in Ottawa, and is at present in the writer's custody. Other essential accessories such as eye-pieces, levels, magnifiers for the vernier scales, etc., are not with the instrument and parts such as a tangent screw for fine adjustment have been damaged at some time in the past. The base bears the manufacturer's inscription, "Troughton and Simms, London 1872, T.S. 394," and elsewhere on the base plate one can read "Fo 1." The objective lens is $2\frac{3}{8}$ inches diameter, and is placed in a tube 30 inches long. The vertical circle attached to the telescope tube is $6\frac{3}{4}$ inches in diameter and the horizontal circle is $10\frac{1}{2}$ inches in diameter. The weight of the instrument is 65 lb. The objective glass has been removed into a more suitable astronomical mount by members of the Observers' Group and has thus been brought into service once more. Inquiries about the history of the instrument reveal that it has always been around the Observatory in Ottawa. With this clue in mind, a search has been made of some of the past volumes of the Journal of the Society and has brought to light the reference previously mentioned. A liberal quotation from this article has been made for its description of early Canadian conditions. Reference to an instrument which is undoubtedly the same one as shown in the photograph appears in the last paragraph of the quotation.

The Observatory at Ottawa to-day is an evolution of the astronomic work inaugurated in 1885 in connection with the Railway Belt in British Columbia.

British Columbia entered Confederation, became part of the Dominion of Canada, on July 20, 1871.

One of the conditions upon which British Columbia entered the Dominion was the speedy construction of a trans-continental railway, and in this connection, by the Imperial Order in Council of the 16th May, 1871, British Columbia conveyed in trust

of her Crown Lands to the Dominion " . . . not to exceed twenty miles on each side of the said line" (railway). These twenty miles on each side of the railway are known as the Railway Belt, and became Dominion Lands, to be administered by the Department of the Interior, and furthermore, to be correlated with the Dominion Lands survey system of the Northwest, a system based on geographic co-ordinates.

The mountainous character of British Columbia precluded projecting and running standard base-lines and meridians, as had been done over the wide expanse of prairie from Winnipeg to Calgary and Edmonton. However, another method was available,

and that was to establish a number of astronomic stations accurately determined in latitude and longitude along the railway line, and furthermore to make a very accurate azimuth survey of the railway connecting the survey with the astronomic stations. With these data it was thus possible to compute with precision the position on the earth, that is, in latitude and longitude, of every point of the railway, and hence the position it would occupy were the rectangular net of Dominion Lands Survey spread over the Railway Belt, becomes known. The distance involved in this survey was 512 miles, extending from Port Moody, the original Pacific terminus, to the summit of the Rocky Mountains.

In 1885 there was no Vancouver; it subsequently became the terminus. Accordingly in the spring of 1885 (the last spike of the railway was driven at Craigellachie on November 7, 1885), the Surveyor General, E. Deville, issued instructions to two astronomers, T. Drummond and Otto Klotz, to make the astronomic observations, and to W. Ogilvie to make the azimuth survey. It may be noted that the official use of the word astronomer by the Department was for the first time made in the above case.

The beginning was made from the Pacific end of the line, and the writer had charge of the astronomic work. The nearest well-determined point was Seattle, the astronomic position being determined by the U.S. Coast and Geodetic Survey, its longitude being based on Greenwich. Hence Seattle became the initial point for our longitudes, and from it were established Victoria and Kamloops, the latter becoming in turn the basal longitude station, to which were referred Port Moody, Revelstoke, Field and other stations as far east as Winnipeg.

The astronomic equipment consisted of two Troughton and Simms portable transits, Fo.1, and Fo.2, each of 2½-inch aperture and 28 inches focal length, previously used on the 49th parallel Boundary Survey of 1872–1874; two sidereal box chronometers by Dent and Frodsham, respectively; two pocket chronometers; one zenith telescope for latitude work, and two standard registers.

R.A.S.C. PAPERS

As part of the programme in connection with the Annual Meeting held in Toronto on March 17–18, 1961, papers were presented by members of the Society. We are printing summaries of some of these in the following pages.—Editor.

OBSERVATIONS OF VENUS

By Klaus R. Brasch
Montreal Centre

Serious observations of Venus by members of the Montreal Centre were begun during the apparition 1959–60. Because accurate visual observations of surface markings, ashen light, and other phenomena of the planet are difficult to make, no definite observational programme was undertaken at that time. An effort was made, however, to try to obtain simultaneous observations by different observers, with various instruments, for the purpose of confirmation. In this we were quite successful on several occasions and, if nothing else was accomplished, it gave us experience and encouragement to continue observing this rather unrewarding planet.

For 1960–61, a much more ambitious and elaborate programme was undertaken. Observations were again to be made simultaneously, in the afternoon and early evening. In addition, however, intensity estimates of the markings were made. The same scale as that used by the A.L.P.O., with 0 as sky black to 10 the brightest, was adopted. On this scale the darkest markings seldom were judged below 8, illustrating the faintness of these features.

A further and very interesting type of observation was made with a violet Wratten 47-B filter. The planet was first observed without a filter and, if anything was seen, a drawing was made. Then the planet was observed with the filter and a second drawing made. In general the markings were more conspicuous with the filter, and often appeared to have different shapes than when seen without it. On several occasions parallel band-like structures were seen, beginning at the terminator and thinning out toward the limb. The cusp areas at the north and south ends of the terminator were often seen much more definitely with the filter. On the whole, a blue or violet filter was found to have considerable use in revealing sharper and more conspicuous detail than could otherwise be seen.

Another rather intriguing experiment was undertaken more or less for curiosity's sake. As is generally known, no definite rotation period for Venus has as yet been established. Although indications are that the period is more than a week and less than a month, times ranging from a few hours to one Venusian year have been quoted.

Certain observers at Pic du Midi Observatory in France hold the belief that Venus, like Mercury, has a rotation period of the same length as the planet's period of revolution and consequently always presents the same face to the sun. It is the belief of these people that Venus is covered with high, dense clouds, in which occasional breaks sometimes reveal markings of lower levels. By superimposing numerous observations they have thus produced a map of what they believe to be more or less permanent markings. A reproduction of this map can be found in the *Larousse Encyclopedia of Astronomy*.

Based on the above assumption, and for a lack of a more concrete programme, we have attempted a similar experiment despite the fact that none of us has much faith in the idea.

Several of the best drawings by the most experienced observers and only those made with instruments of 6-inch or over and under fair or better seeing conditions were transferred to tracing paper, superimposed, and an outline made of the darkest and most prominent markings.

In this manner a map of each observer's observations was made and, with allowances made for different drawing styles, a final map was produced from about 30 observations. The agreement between our map and that made at Pic du Midi cannot be said to be very convincing. However, it should be brought to mind that our map is based on rather few observations made with smaller instruments, inferior seeing and less experienced observers than the one made at Pic du Midi. Furthermore our map is based almost entirely on direct observations, while the French map is based mainly on filter observations.

A further experiment that may be undertaken is one in which the same superimposing method may be used coinciding with a certain rotation period, in which case appropriate calculations and corrections would have to be made. This, however, would be very difficult to do and very time-consuming.

Thus, as with all experiments and observations of Venus, nothing is definitely proven or disproven, no conclusions can be reached, and in fact one knows no more about the planet than before, except that people will go on observing and speculating about this truly fascinating planet.

THE ROLE OF OUR ASTRONOMICAL SOCIETY IN TODAY'S NEIGHBOURHOOD

By Franklin C. Loehde
Edmonton Centre

With the coming of man's first step into space no longer a distant dream but rather a firm reality and the public's appetite whetted to true tales of outer space and time, the Society finds itself in a new role—that of educator and motivator. The opportunity has arisen to use this interest as a means to an end—the end being the desire to explore the innumerable facets of the world around us. A by-product of this end, of course, would be encouragement to attain a more extensive academic background through our schools and universities.

With this increased interest in mind the Society can take concrete steps toward that end. A few which may be taken are:

1. Greater use of communication media for local activity of astronomical groups.
2. Co-operation with school boards in providing teachers qualified to teach the highly motivating subject of astronomy.
3. Association with young people's groups such as the Boy Scouts and Girl Guides.
4. Special public lectures on an elementary level, progressing to more advanced levels.
5. Acquisition of planetaria which are educating and entertaining.

INTER-CENTRE COMMUNICATION VIA AMATEUR RADIO

By David Sands
Montreal Centre

An explanation of the present structure of the amateur radio system was given together with original ideas on how amateur radio can be used in observational astronomy. The work done in this field by the Montreal Centre before March 1, 1960 was described. An outline of the programme used for the eclipse of March 12–13, 1960 was given, along with the results obtained. After procuring a radio licence for the Montreal Centre, a preliminary station was constructed and tested. This led to the purchase by the Centre of an amateur radio station. The work done to date by the radio station was described. Possibilities for the use of amateur radio communication among Centres were outlined.

PLINIUS—DETAILS OF AN INVESTIGATION INTO THE NATURE OF THE CENTRAL MASS

By D. J. Fitzgerald
Toronto Centre

A controversy exists concerning the nature of the central mass in the lunar crater Plinius. Two small dark shadows are prominent in the centre of the crater under sunrise illumination and the question is whether these are caused by craterlets or some other formation such as mountain peaks. Observations and drawings by members of the Toronto Centre as well as photographs in Kuiper's *Atlas* give them a distinct crater-like appearance under sunrise illumination. However, at sunset their aspect is considerably different. In fact, under certain comparable sunset illumination, the central mass gives no hint of any crater-like formations.

In order to gain some insight into the true nature of the formation which gives such an apparently contradictory appearance, I have constructed a model of the crater on a scale of 1 inch equals 4 miles, using for my basic dimensions those given by Wilkins and Moore (with the exception of depth, where I believe they have erred on the conservative side). For the shape of the ramparts (exterior and interior), floor detail and the central mass, four photographs from Kuiper's *Atlas* were used (two at sunrise and two at sunset illumination). I succeeded in getting a rough approximation to the appearance of the crater as shown in the four photographs. Then I attempted to fill in detail at other illuminations from drawings submitted by observers of the Toronto Centre.

The model, properly illuminated, will duplicate the phenomena mentioned earlier, namely two crater-like shadows which are prominent at sunrise but nonexistent at sunset illumination. The model indicates that the crater floor slopes downward in a westerly direction. The central objects are shallow depressions in the slope without any appreciable raised rims which, because they are tilted at the same angle as the eastern slope itself, cast shadows when the illumination is from the west, but offer no obstacle to the sun's rays when the illumination is from the east.

It should be emphasized that this project is far from complete: many more observations are required, particularly at sunset illumination. The model itself is incomplete in the sense that many of the finer details contained in it may be proved invalid by future observations. However, it is felt that the main features of the central mass in Plinius are now correctly interpreted.

THE BRUDERHEIM METEORITE

By Earl R. Milton, H. Baadsgaard, R. E. Folinsbee and L. A. Bayrock
Edmonton Centre, University of Alberta and Research Council of Alberta

A detonating meteorite entered the earth's atmosphere at 1:06 a.m. M.S.T. on March 4, 1960. Fragments were soon discovered near Bruderheim, Alberta, and members of the Edmonton Centre were instrumental in facilitating purchase of these fragments by the University of Alberta.

Studies have been made from visual reports of the fireball and of sounds heard at various locations near the fall zone, and it has been concluded that the meteorite entered the atmosphere at a speed of close to 8 miles per second and that an explosion occurred close to 20 miles above the surface.

Fragments have been recovered in an ellipse of fall 3.3 miles long by 2 miles wide. Inside this ellipse a total of 188 sizable individual particles weighing 303 kilograms have been recovered. The largest piece weighed 31 kilograms. There are still over 500 particles smaller than 100 grams which have been found but are as yet uncatalogued.

Chemical analyses have been made and show the Bruderhaim meteorite to be a grey chondrite with low iron content. Age date results have yet to be completed. (See this Journal, vol. 55, p. 218)

PROFILE OF THE FOSSIL CRATER AT BRENT, ONTARIO

By M. J. S. Innes and C. S. Beals
Dominion Observatory, Ottawa, Ontario

Ten diamond drill holes were sunk in the Paleozoic sediments and other material filling the Brent crater in order to determine its pre-deposition profile and compare it with known meteorite craters. At the centre the drilling revealed 850 feet of sediments with the depth steadily decreasing toward the circumference. The crater surface was found to consist of gneiss breccia with fragmental dimensions ranging from a fraction of a millimetre to a metre or more. Apart from the absence of a raised rim (explicable on the basis of erosion) the profile was found to resemble closely that of a typical meteorite crater.

THE ROLE OF A PLANETARIUM IN THE ASTRONOMICAL SOCIETY

By Ian McLennan
Edmonton Centre

The role a planetarium can play in the functioning of an Astronomical Society is one that we in Edmonton are only beginning to realize. The significance of the Queen Elizabeth Planetarium—what it has meant to our Centre, and to the entire community—is something far beyond our greatest expectations. The basic ingredient for the success of the Edmonton Planetarium has been the interest in astronomy that has spread throughout our entire community since the planetarium was officially opened in September 1960. In this short time, over 10,000 people have attended shows presented with the assistance of members of the Edmonton Centre. The interest which has been aroused has resulted in a flood of requests for information regarding membership in the R.A.S.C. Naturally, this can only help the Society, and will, in time, be equally beneficial to the planetarium, as more people will be called upon to present star shows, handle classes, work on exhibits, etc. We have become so enthusiastic about the Queen Elizabeth Planetarium that we are convinced that every other major Canadian city should examine the possibility of a similar operation. A "network" of planetariums stretching from coast to coast functioning in co-operation with each other, and with the R.A.S.C. would provide the entire country with a form of education combined with entertainment that *cannot* be equalled in any other field. Ultimately, it could broaden the scope of our success, and spread it across the entire nation.

METEOR TRAIL EFFECTS ON HIGH-FREQUENCY RADIO WAVES

By Bryan Rawlings
Montreal Centre

During the last twenty years increasing uses have been found for radio waves of the very-short and ultra-short variety or, in other words, frequencies above about 30 Mc./s. These frequencies are distinctive in that they lie normally above a line of demarcation referred to as the maximum-usable-frequency or MUF. This is the highest frequency on

which a radio wave sent out horizontally to the earth's surface will return to earth—the effect which produces the phenomenon of short-wave radio. Radio services using frequencies higher than 30 Mc./s. therefore could depend only upon line-of-sight ranges. As radio services moved into the very-high-frequency region (30–300 Mc./s.), certain phenomena were found to produce sporadic exceptions to this rule, most notably sporadic *E* skip, a mysterious ionospheric phenomenon active up to about 125 Mc./s., and various tropospheric scatter and ducting phenomena which by now have been fairly well documented.

These interesting occurrences prompted a number of individuals to investigate freak propagation of commercial television stations (now numbering about 600 in the United States and Canada). Early in 1952 an alert viewer in Oklahoma noted that in times when no tropospheric or ionospheric disturbances were in progress short bursts of signals could be seen on his television screen lasting on an average a few seconds. Increased study associated these bursts with meteors entering the upper atmosphere and identification of the signals showed that the stations were from 300 to 1,000 miles distant from the viewer.

In the summer of 1957, I began observations of this kind using the following method: a high-gain antenna was pointed in the direction of the desired station about 500 to 900 miles distant at a time when the station was known to be transmitting a test pattern which normally carries the station's call letters, and the bursts were noted. On August 11, 1957 at 1134 E.S.T. a series of short bursts was seen of the test pattern of WDSM-TV, Duluth, Minn., on Channel 6, or at a video frequency of 83.25 Mc./s. This station lies west and slightly north of Montreal at a distance of 900 miles. Ten days later, on August 21, 1957 station WCIA, Champaign, Ill., was seen over Channel 3 (61.25 Mc./s.) at a distance of 800 miles. During the following months nearly every U.S. television station was seen on Channels 2, 3 and 4, and as the procedure improved daily reception became feasible. It should be noted that "reception" here means a series of bursts lasting a dozen or more seconds at the very most, coming at regular intervals during the observations (not continuous reception). To date 22 stations have been identified from Montreal, the closest being WBAL-TV, Channel 2, in Baltimore, Maryland at 450 miles and the most distant being WMT-TV, Channel 2, in Cedar Rapids, Iowa.

The most striking thing by far has been the reliability of this form of radio propagation. Signals can be seen and identified 365 days a year. Although no comparative counts have been made, there is evidence of a sharp rise in the number of bursts seen in a given time period during

meteor showers. In mid-January of this year, I began counting the number of bursts seen on Channel 2 (54–60 Mc./s.) in a ten-minute period with an aim toward obtaining an average value for non-shower conditions; however, the severe storm that struck Montreal on the night of February 25 destroyed the receiving antenna and associated equipment used for these tests. In all, five observations have been made. They are as follows and each is for a timed ten-minute period: January 18 from 0756 to 0806 E.S.T.—52 bursts; January 23 from 0754 to 0804 E.S.T.—44 bursts; January 24 from 0752 to 0802 E.S.T.—61 bursts; February 10 from 0754 to 0804 E.S.T.—29 bursts; and February 20 from 0757 to 0807 E.S.T.—66 bursts. The average of these values is just over 50 bursts per ten-minute period or a burst about every 12 seconds. In making these observations only bursts distinctly characteristic of meteor bursts were recorded. Since the stations seen on these bursts were mainly in the U.S. midwest at about 600 to 800 miles from Montreal by air, the meteor trails were probably over the Great Lakes region at about the mid point from the station to Montreal. It is my intention to re-install antenna equipment in the near future and to make observations during meteor showers and to compare these values with the non-shower values just given.

The antenna used was about forty feet above ground, of nine elements mounted in an electric rotator. Since my location in Montreal is about 300 to 400 feet above the average terrain around the Island of Montreal, it is only necessary to clear nearby obstructions to have line-of-sight conditions for fifty miles or more to the south and west. The signal from the antenna is fed without any pre-amplification through about seventy-five feet of 300 ohm tubular transmission line to the receiver—a standard 1954 Admiral 21-inch chassis. I have been wary of using any amplification before the television receiver for the reason that these devices (popularly called boosters) tend to raise rather than lower what is known as the noise-figure of the receiving system while at the same time creating the impression of increased gain. For the last several months, however, I have been using an imported frame-grid dual triode tube in the receiver with a noticeable decrease in noise figure.

In general, these observations have been carried out in the morning hours between 6:00 and 8:00 a.m. for three reasons: (1) TV stations generally carry test patterns during these hours, (2) local Montreal stations are off the air at these times, and (3) the earth will intercept the maximum number of meteors during this period.

In the past six years I have logged 57 additional stations on other programmes of upper-atmosphere phenomena for a total of 79 stations

in two Canadian provinces and twenty-seven U.S. states. Verifications are on hand from most of the stations received; attempts have been made to photograph bursts but because of the extremely short duration have not always been successful. These reports of meteor scatter reception are kept on file at the Montreal Centre as one of the programmes of the Radio and Electronics Section of the Observation Committee of the Centre.

GALACTIC NUCLEI

By Frank P. Morgan
Montreal Centre

Recently there has come to light some evidence that Maedler's theory that a massive star is at the centre of each galaxy may be partly correct. Although there can be no such thing as a controlling star, this does not rule out the possibility of a central star of greater mass than any other individual star within the system, although its mass would only be a negligible fraction of that of the entire galaxy. Until recently, there was no reason for such an assumption. Now, there is evidence that the centre of at least one elliptical galaxy (M87 in the Virgo cluster) is occupied by such a star.

NOTES FROM OBSERVATORIES

Dominion Observatory, Ottawa, Ontario

Positional Astronomy. C.H.U. time signals were advanced 50 milliseconds at zero hours UT August 1 to close the gap between the atomic regulated time and astronomically determined time UT2, the latter having been affected by changes in earth rotation. The Photographic Zenith Telescope, in addition to being automatic in operation, is programmed for electronic reduction. Commencing September 1, weekly summaries of UTO (referred to WWV) as well as latitude observations, were sent to the BIH. The AGK3R programme of the Meridian Circle was completed in May, another year being required for the FK3 Supplementary stars. Instrumental constants of the Mirror Transit are being investigated and first star exposures have been made. While this instrument is adapted to both visual and photographic operation, the latter appears to offer overwhelming advantages.

Stellar Physics. Observations with the 84-foot radio telescope at Penticton have yielded detailed contour maps of the intensity of neutral hydrogen in a region in Auriga. Plans for the construction of a large low-frequency antenna array, to operate near 22 mc./s., are nearly complete. A new double-slide camera attachment for the 15-inch refractor at Ottawa has been installed and tested. The solar magnetograph has been installed on the large solar spectrograph and preliminary tests are in progress. Several spectrographs at Meanook and Newbrook photographed a spectacular Lyrid meteor in April. One spectrogram shows great detail with a dispersion of 15 A./mm., which is a considerably higher dispersion than is normally achieved.

Geomagnetism. The Dominion Observatory three-component airborne magnetometer was flown in a Nordair 4-engine aircraft a distance of 52,000 miles. This entailed 221 hours flying time on east-west lines approximately 70 miles apart, between eastern Quebec and the Rocky Mountains and extending from the Canada-U.S.A. border northward to latitude 60°, with an extension up to latitude 64°. The results are being reduced by electronic computer for inclusion in revised magnetic charts of Canada.

Gravity. An interesting project carried out this summer was a series of underwater gravity observations on the floor of Hudson Bay. A remote control LaCoste gravimeter capable of observing to depths of 1,200 feet

from a surface vessel was employed. These measurements are expected to provide important information concerning the structure of the crust underlying Hudson Bay and to serve as control measurements for testing apparatus now being developed for surface observations from a moving vessel.

Seismology. Good progress has been made in the programme for the expansion of the seismological network. Possible sites have been explored in the central Arctic and in the Prairie Provinces and the planning stage of the expansion is almost at an end. The vaults at Alert and Mould Bay are now under construction and it is hoped that the stations will be installed by the end of September. Construction will start very shortly on the vault at Schefferville and on new vaults at Ottawa.

Personnel. Recent visitors have included Dr. M. P. de Barros, Oporto, Portugal, who spent September studying our new Mirror Transit; Dr. R. H. Hardie, recently appointed Director of Dyer Observatory, Nashville, Tennessee; Dr. B. A. Lindblad, Lund, Sweden; Dr. S. Laustsen of Brorfelde, Denmark; Dr. R. O. Redman of Cambridge, England; Dr. R. H. Stoy of Cape Town, South Africa; and Dr. R. O. Vicente of Lisbon, Portugal. Papers were given by staff members on a number of occasions, and meetings were attended as follows: Royal Society of Canada, Montreal: C. S. Beals, G. A. Brealey, V. Gaizauskas, I. Halliday, V. E. Hollinsworth, J. L. Locke, M. M. Thomson. American Astronomical Society, Nantucket: C. S. Beals, V. Gaizauskas, J. J. Labrecque, R. W. Tanner. Frequency Control Symposium, Atlantic City: D. L. G. Miller. Meeting to discuss the setting up of an international agency for the centralization of routine seismology, Paris: J. H. Hodgson. Symposium on Gravity Reductions, Cambridge, England: J. G. Tanner. International Astronomical Union, Berkeley: C. S. Beals, Miss M. S. Burland, J. A. Galt, I. Halliday, J. L. Locke, R. W. Tanner, M. M. Thomson, E. G. Woolsey. Alaska Science Conference, College, Alaska: Miss A. B. Cook. International Symposium on Meteors, Cambridge, Mass.: I. Halliday. Meeting on Geomagnetic Disturbances, Japan: K. Whitham. Early in September Dr. J. A. Rottenberg was married to Miss Shirley Gibbons and our best wishes are extended to them. Dr. J. L. Climenhaga of Victoria College, Victoria, B.C., spent the summer working with the solar physics group. Staff changes include V. N. Beck who resigned from the Stellar Physics division to undertake graduate studies at University, and J. P. Charette who joined the Gravity division recently.

MIRIAM S. BURLAND

METEOR NEWS

By Peter M. Millman

National Research Council, Ottawa, Ontario

A Report on Meteor Terminology

At the X General Assembly of the International Astronomical Union in Moscow, U.S.S.R., held during the period August 12–20, 1958, Sub-Commission 22B was formed to deal with the problem of a standard terminology for use in meteoric astronomy. At the XI General Assembly, held in Berkeley, California, U.S.A., August 15–24, 1961, the definitions for twenty basic terms were approved and the equivalent words for use in four different languages were recommended.

An attempt was made to keep these definitions simple and straightforward and to adhere as far as possible to the accepted usage in each of the four languages, English, French, Russian, and German. Words like "train" and "trail" were not defined with separate meanings in English, since only one Russian word stands for both. Where a term is needed for the photographic image of a meteor path it is suggested that "track" be used. The approved definitions are given in Table I and the recommended terms for use with these definitions are listed in Table II. To find the "absolute magnitude" of a meteor the "apparent magnitude" must be corrected for distance, to a standard of 100 km., and for absorption, to the standard absorption of one vertical atmosphere. Terms such as "visual meteor", "photographic meteor", "telescopic meteor", etc., should refer only to the method of observation and should not indicate ranges of brightness. The following standard notation is suggested for meteor velocities:

V_a (instrumental velocity):	the uncorrected velocity as recorded by an instrument.
V_o (observed velocity):	V_a corrected for instrumental errors of all types.
V_∞ (no-atmosphere velocity):	V_o corrected for deceleration in the earth's atmosphere.
V_g (geocentric velocity):	V_∞ corrected for rotation of the earth and the gravitational force (zenith attraction) of the earth.

V_h (heliocentric velocity): V_g combined with the vector of the earth's motion around the sun to give the motion of the meteoric particle relative to the sun.

Sub-Commission 22B has now been reorganized as Committee B of Commission 22 of the I.A.U. and it is expected that in the future additional terms will be added to the initial list. The new chairman of this Committee B is Dr. L. Jacchia, Smithsonian Astrophysical Observatory, 60 Garden Street, Cambridge 38, Massachusetts, U.S.A. He will welcome further suggestions from those active in meteor research.

TABLE I

BASIC DEFINITIONS IN METEORIC ASTRONOMY

A. *meteor*—in particular, the light phenomenon which results from the entry into the earth's atmosphere of a solid particle from space; more generally, as a noun or an adjective, any physical object or phenomenon associated with such an event.

B. *meteoroid*—a solid object moving in interplanetary space, of a size considerably smaller than an asteroid and considerably larger than an atom or molecule.

C. *meteorite*—any object defined under B which has reached the surface of the earth without being completely vapourized.

D. *meteoric*—the adjectival form pertaining to definitions A and B.

E. *meteoritic*—the adjectival form pertaining to definition C.

F. *fireball*—a bright meteor with luminosity which equals or exceeds that of the brightest planets.

G. *micrometeorite*—a very small meteorite or meteoritic particle with a diameter in general less than a millimetre.

H. *dust*—when used with D or E—finely divided solid matter, with particle sizes in general smaller than micrometeorites.

J. *absolute magnitude*—the stellar magnitude any meteor would have if placed in the observer's zenith at a height of 100 km.

K. *trajectory*—the line of motion of the meteor relative to the earth, considered in three dimensions.

L. *path*—the projection of the trajectory on the celestial sphere, as seen by the observer.

M. *train*—anything (such as light or ionization) left along the trajectory of the meteor after the head of the meteor has passed.

N. *persistent*—an adjectival form for use with M indicating durations of some appreciable length.

O. *wake*—train phenomena of very short duration, in general much less than a second.

P. *radiant*—the point where the backward projection of the meteor trajectory intersects the celestial sphere.

Q. *earth-point*—the point where the forward, straight-line projection of the meteor trajectory intersects the surface of the earth.

R. *zenith attraction*—the effect of the earth's gravity on a meteoric body, increasing the velocity and moving the radiant towards the zenith.

S. *orbit*—the line of motion of a meteoric body when plotted with reference to the sun as origin of co-ordinates.

T. *shower*—for use with A or D—a number of meteors with approximately parallel trajectories.

U. *stream*—for use with A or D—a group of meteoric bodies with nearly identical orbits.

TABLE II

TERMS RECOMMENDED FOR USE IN CONNECTION WITH THE DEFINITIONS IN TABLE I

	English	*French*	*Russian*	*German*
A.	meteor shooting star	météore étoile filante	метеор падающая звезда	Meteor Sternschnuppe
B.	meteoric body meteoric particle meteoroid	corps météorique particule météorique	метеорное тело метеорная частица	Meteorkörper Meteorteilchen
C.	meteorite	météorite	метеорит	Meteorit
D.	meteoric	météorique	метеорный	meteorisch Meteor-
E.	meteoritic	météoritique	метеоритный	meteoritisch
F.	bolide fireball	bolide	болид	Feuerkugel
G.	micrometeorite	micrométéorite	микрометеорит	Mikrometeorit
H.	dust	poussière	пыль	Staub
J.	absolute magnitude	magnitude absolue	абсолютная величина	Absolutgrösse
K.	trajectory	trajectoire	траектория	Trajektorie atmosphärische Bahn
L.	path	trajectoire apparente	путь	Bahnspur scheinbare Bahn
M.	train	trainée	след	Schweif
N.	persistent enduring	persistant	длительный долговременный	andauernd
O.	wake	sillage	хвост кратковременный след	Schweifansatz
P.	radiant	radiant	радиант	Radiant Ausstrahlungspunkt
Q.	earth-point	point terrestre	земная точка	Erdpunkt
R.	zenith attraction	attraction zénithale	зенитное притяжение	Zenitverschiebung Zenitattraktion
S.	orbit	orbite	орбита	Bahn
T.	shower	averse	поток дождь	Schauer
U.	stream	essaim courant	рой	Strom

NOTES

R.A.S.C. General Assembly 1962

Beginning in 1958, a feature of the annual two-day meetings of The Royal Astronomical Society of Canada has been a session for papers of general astronomical interest prepared by members of the Society. Members are again invited to submit papers for presentation at the next General Assembly, to be held in Edmonton, Alberta, on May 18–19, 1962. The papers should not be more than 10 minutes in length and must be approved as to the suitability of content for presentation.

Attention is now drawn to the dates of this meeting in order that members will have ample time to prepare their material. It is requested that papers, or a detailed abstract of these, be submitted to the Committee for review before April 15, 1962. All papers must be approved by this Committee and, in the event of a crowded programme, the number of papers presented may be limited. Members attached to Centres should submit their papers to the Council of their Centre for approval and for onward transmission to the Committee.

Further information may be obtained from the Chairman of the Committee for Papers, Dr. K. O. Wright, Dominion Astrophysical Observatory, Victoria, B.C.

K. O. Wright
Anne B. Underhill
J. L. Climenhaga

R.A.S.C. Awards

Readers of the Journal are reminded that nominations for the Chant Medal and for the Service Award have been solicited from the Centres by the chairmen of these Committees (Dr. J. F. Heard and Mr. J. E. Kennedy, respectively). The conditions governing these two awards were published in vol. 53, p. 232 of the Journal. A new award, the Membership Certificate, was initiated this year by the Society; it is given to members of at least five years' standing in recognition of service to the Society.

Editor

VARIABLE STAR NOTES

By Margaret W. Mayall

The American Association of Variable Star Observers, Cambridge, Mass.

One of the largest commissions of the International Astronomical Union is Number 27 on Variable Stars, in spite of the fact that Sub-Commissions 27b, Variable Stars in Clusters and 27c, Spectra of Variable Stars, and Commission 42, Photometric Double Stars, have been formed to help relieve the heavy load on Commission 27. During the assemblies of the Astronomical Union, many joint meetings are held to discuss problems which concern several commissions, such as photometry and variable stars, spectra and variable stars, radial velocities and variable stars, etc.

At the recent meeting of the International Astronomical Union in Berkeley, many interesting discussions were held. As usual, it was emphasized that variable star observations of all kinds are needed; visual and photographic for the great majority of the stars which have large ranges and fairly slow changes in brightness, and photoelectric for stars with small amplitudes and those which have extremely rapid changes. Photoelectric observations are essentially very slow, and require an operator with a certain amount of experience and knowledge of electronics. A run on one variable may occupy a whole evening, so, until the time comes when there is a photoelectric photometer in every back yard (!), visual observations are necessary.

At one of the meetings of Commission 27, it was pointed out that many of the smaller amateur variable star associations publish their observations in journals which have limited distribution, and are often missed by the professional astronomers. The suggestion was made that it would be very useful, if one of the larger associations, such as the A.A.V.S.O., would collect all observations and combine them to form mean curves. Each association could continue to publish their individual observations, so they would be available for special studies. The A.A.V.S.O. has agreed to do this, and we are sending letters to all known variable star groups to ask their co-operation.

Observations to be included in the means should be sent to A.A.V.S.O. headquarters monthly or quarterly. They should be received not later than six weeks after the end of the quarter. We would hope to have the publication ready for distribution within 4 to 5 months after the date of the latest observation included.

The publication of all variable star observations will follow the form set up in A.A.V.S.O. Quarterly Reports. Ten-day means will be given for long-period variables with no rapid changes, with 5-day and 1-day means where necessary to define the curve to best advantage. Rapidly changing and erratic variables would, of course, have individual observations published. Full credit will be given to each group which contributes observations, and references will be printed giving the sources of publication of individual observations. We hope this will be of mutual benefit to our local and national groups and to the professional astronomers.

One of the most exciting variable star discussions centred around a report given by Dr. Robert Kraft of the Mount Wilson and Palomar Observatories, on his work on the U Geminorum stars. The five brightest stars of the type have been found to be binary stars, and two others are almost certainly binary. The two components of the binary are a dwarf G-type star with narrow absorption lines and a hot subdwarf star with

emission lines. Dr. Kraft found that the characteristics of these binaries were very similar to the W Ursae Majoris stars, with periods less than 1 day. He determined the following periods: SS Cygni, $6^h\,38^m$; U Geminorum, $4^h\,10^m$; RU Pegasi, $8^h\,54^m$; RX Andromedae, $5^h\,9^m$; and SS Aurigae, $3^h\,30^m$.

It is thought that the sudden brightening by several magnitudes of these stars may be caused by a mass exchange of the close binary systems. One component builds up its atmosphere until it exceeds the limiting size and gas streams off towards the smaller companion. The outbursts may be a means of ejecting the excess material from the smaller star. This is the process which is assumed to have caused the outbursts of the novae T Coronae Borealis and DQ Herculis, which are also close binary systems.

There is great interest in the ultra-short-period RR Lyrae-type variables, and several rather bright ones have been discovered. CY Aquarii, with a period of about 88 minutes is the shortest known. It is followed by one recently discovered by Churms, H.D. 199,757, in Microscopium, with a period of 97 minutes. Others are: DY Pegasi, $1^h\,45^m$; AI Velorum, $2^h\,40^m$; V703 Scorpii, $2^h\,45^m$; and DY Herculis, $3^h\,34^m$. A search for more of these interesting objects can be made by means of photographs with long series of very short exposure images.

Dr. Fritz Zwicky of Mount Wilson and Palomar Observatories reported on his supernova survey. Eight observatories scattered around the world are taking part in the survey. About 100 supernovae have been discovered since 1885, but it is estimated that they actually occur at the rate of about 40 per year.

Professor B. P. Kukarkin of the Sternberg Astronomical Institute in Moscow, made the welcome announcement that the first supplement to the second edition of the *General Catalogue of Variable Stars* is now ready for distribution. It contains information about 796 variable stars which have been named since 1958, and additional data for 1647 variables of the *General Catalogue*.

Another catalogue which has always been of great value for research work on variable stars is the *Geschichte und Literatur der Lichtwechsels der Veranderlichen Sterne*. In 1960 the first part of the fifth volume of the second edition was published by Prof. Schneller of Potsdam, Germany. It contained data and references for the variables in the constellations Andromeda through Cygnus, which were named between 1938 and 1958. The second part for the constellations Delphinus through Perseus has just been published. When the third part is completed, references to all variables in the second *General Catalogue* will be listed in the volumes of the *G. und L.*

A.A.V.S.O. Nova Search Report (from George Diedrich, Chairman). Observations of nova search areas were made by the following 18 observers for a total of 459 area-nights reported. Each name is followed by the number of observations made in May and then June, 1961. N. Amor—7, 10; J. G. Avery—32, 29; B. K. Buckman—10, 0; DeLorne Diedrich—11, 10; George Diedrich—11, 9; M. C. Frazer—0, 7; Wm. Isherwood, Jr.—14, 15; V. A. Lee—0, 5; D. W. Orchiston—33, 0; W. S. Renn—12, 11; J. R. Ritson—24, 15; E. K. Sharrock—46, 30; F. Traynor—24, 0; T. B. Tregaskis—8, 0; G. Vodrazka—9, 0; Donald Ward—10, 3; R. F. Ward—26, 26; Karl A. Wells—0, 12.

Observations received during July and August 1961: A total of 13,358 was received: 3300 from 87 observers in July, and 10,058 from 129 observers in August.

Observer	July		August		Observer	July		August	
	Var.	Ests.	Var.	Ests.		Var.	Ests.	Var.	Ests.
Abbey, W.	...	...	2	4	Fuller, K.	...	...	6	6
Acuna, M.	...	...	12	14	Gardner, B. E.	10	12	...	...
Adams, R. M.	98	165	80	165	Geerdts, M. T.	...	...	10	16
Aguirre, C.	...	...	6	6	Giordano, P.	...	...	24	64
Aguirre, S.	...	...	1	20	Glenn, F. R.	3	3	...	...
Aguirre, V. H.	...	...	15	191	Glenn, W. H.	3	4	...	...
Alvarez, I.	...	...	6	6	Gonthier, A.	4	4	6	10
Anderer, J. A.	2	3	...	...	Gonzales, R.	...	...	24	29
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Berzano, M. E.	...	...	1	1	Izquierdo, V.	...	...	10	23
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Brady, R. F.	8	8	20	24	Ledbetter, N.	...	...	16	29
Bream, G.	8	8	17	25	Lewindon, F.	...	...	2	3
Buckman, B. K.	...	...	1	5	Loocks L., S.	...	...	5	8
Buckstaff, R. N.	18	63	18	45	Lorca, A.	...	...	3	8
*Burt, S. E.	16	57	...	...	Lorenz, E. O.	2	2	49	63
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Celis S., L.	...	...	33	567	Lynch, J. S.	...	...	6	6
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Davis, R. H.	7	7	8	8	Maran, S. P.	...	...	1	1
Debono, I. P.	...	...	3	12	Marcovitcs, G.	...	...	12	350
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Diedrich, DeL.	2	2	3	3	McPherson, C. A.	24	24	...	...
Diedrich, G.	8	12	3	7	Melendes, S.	...	...	13	14
Ellerbe, J. E.	2	2	...	...	Mena, M.	...	...	4	7
Engel, A.	...	...	3	3	Mende, R.	1	2	...	...
‡Engelkemeir, D.	6	9	4	6	Menzel, K.	...	...	5	17
Erpenstein, O. M.	...	...	4	4	Miller, R. W.	8	12	13	13
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Fernandes, M.	4	50	...	...	Molina, W.	...	...	9	9
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Frogel, J. A.	5	5	...	...	Moroni, J. C.	...	...	4	5

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Observer	July		August		Observer	July		August	
	Var.	Ests.	Var.	Ests.		Var.	Ests.	Var.	Ests.
Morgan, F. P.	6	9	...	...	Salce M., H.	...	...	12	13
Mourilhe S., P.	13	38	15	59	Sallings, B. L.	2	2	...	...
Muniz B., L.	2	5	...	...	Schiff, S.	1	1	...	...
Newton, C. S.	1	1	...	...	Schilling, M.	...	...	8	13
Oberstatter, A.	10	17	...	...	Schmidt, E.	2	5	...	...
Oravec, E. G.	118	281	118	157	Sharpless, A. P.	15	15	19	20
Orchiston, D. W.	...	...	30	65	Shayler, R. K.	2	3	11	17
Ormazabal, M. E.	...	...	6	6	Sheldon, L.	5	6	3	3
Ortiz, E.	...	...	23	138	Sherwood, D. A.	8	8	17	23
Overbeek, M. D.	...	...	83	290	Shinkfield, R. C.	...	...	12	16
Paulton, E. M.	9	11	4	4	Smith, J. R.	19	23	7	7
Pearlmutter, A. E.	24	24	...	...	Sobrinho, M. R.	6	7	3	3
Peltier, L. C.	36	254	58	304	Solano S., S.	...	...	20	68
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Pizarre, C.	...	...	4	4	Taboada R., D.	...	...	34	36
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Quester, W.	7	21	...	...	Teran, M.	...	...	2	2
Quiroga, R.	...	...	2	2	Traynor, F. N.	...	...	14	30
Rawstron, G. O.	9	15	10	15	Tsai, C. H.	24	49	22	33
Renner, C. J.	...	...	190	191	Valles, T.	...	...	2	2
Rettig, P.	...	...	4	5	van Zyl, L. L.	47	85	37	98
Riquelme, J.	...	...	4	4	Venegas, J.	...	...	11	21
Riveros, R.	...	...	1	1	Vodrazka, G.	...	...	9	38
Rizzo, P. V.	9	11	7	8	Weitzenhoffer, K.	...	...	1	1
Robinson, L. J.	20	28	1	1	Wend, R. E.	1	1	...	...
Rocha, A. S.	4	4	...	...	West, D. E.	...	...	1	2
Rocha, N.	...	...	1	2	Williams, I.	1	1	...	...
Rojas, J.	...	...	4	4	Williams, J.	1	1	...	...
Rosebrugh, D. W.	10	53	8	46	Yelle, R.	1	2	5	5
Royer, R.	...	...	16	35	Zit, R.	1	1	...	...

REVIEW OF PUBLICATIONS

Stellar Atmospheres edited by Jesse L. Greenstein. Pages xix + 724; $6\frac{3}{4} \times 9\frac{1}{2}$ in. Chicago, University of Chicago Press, 1960. Price $17.50.

This book forms Volume VI of the compendium *Stars and Stellar Systems* which is edited by Gerard P. Kuiper and Barbara M. Middlehurst. The set of nine volumes is designed to give a comprehensive survey of astronomy and astrophysics. These books are expected to be useful to the graduate student and to specialists who wish to survey a field outside their own field of specialisation. The volume *Stellar Atmospheres* fills this aim exceptionally well and it will form a valuable addition to any technical library. The amateur astronomer might find some of the articles hard going, but with perseverance he would be rewarded with a thorough grounding in the theory of stellar atmospheres and with a comprehensive survey and interpretation of normal and peculiar stellar spectra. The detailed table of contents and the indexes permit rapid finding of individual items of interest. There is a most valuable index of stars studied and a list of the catalogues and special lists of stars which are reviewed, as well as a list of the tables of certain types of star which are included in some of the chapters. Each chapter is followed by a comprehensive bibliography. All of the chapters are authoritative and critical review articles. Many give new material not published elsewhere.

Chapters 1 to 3 review the basic theory of stellar atmospheres. The different viewpoints of these chapters are all required if the complexities of the subject are to be understood. Chapter 1, The Theory of Model Stellar Atmospheres, is by Guido Münch. Here the basic theory of stellar atmospheres is reviewed and a summary is given of the methods that have been developed for constructing numerical analogues of stellar atmospheres. Chapter 2, Stellar Energy Distribution, is by A. D. Code. The methods of measuring the stellar energy distribution are discussed critically and a summary is given of some of the newest techniques. New data are presented on the intensity distribution in the continuous spectrum of some bright stars. Chapter 3, Basic Theory of Line Formation, is by Karl-Heinz Böhm. The physics of the formation of stellar absorption lines is reviewed critically. The treatment, of necessity, is highly technical, but it is clear and the many complexities of the problem are delineated in a masterly manner. Both chapter 4, Quantitative Analysis of Normal Stellar Spectra, and chapter 5, Interpretation of Normal Stellar Spectra,

are by Lawrence H. Aller. In these chapters a historical summary is given of the development of methods of analysing stellar spectra and the methods are discussed critically with examples of how they are used.

Five chapters review further physical phenomena that are displayed by stars. Each gives a comprehensive survey of the title subject. They are chapter 6, Non-Thermal Phenomena in Stellar Atmospheres, by L. Biermann and R. Lüst; chapter 7, Stellar Magnetic Fields, by H. W. Babcock; chapter 8, Stellar Rotation and Atmospheric Turbulence by S. S. Huang and O. Struve; chapter 15, The Loss of Mass from Red Giant Stars, by Armin J. Deutsch; and chapter 16, Isotopes in Stellar Atmospheres by Andrew McKellar.

In the remaining chapters the spectral characteristics of certain types of star are discussed in detail. Each author has made an effort to collate and review material that has appeared in many scattered publications. Much new observational material is also contained in these chapters. The following subjects are covered: chapter 9, The Spectra of Supergiants and Cepheids of Population I, by Robert P. Kraft; chapter 10, Early-Type Stars with Extended Atmospheres, by Anne B. Underhill; chapter 11, Eclipses by Extended Atmospheres, by O. C. Wilson; chapter 12, Composite and Combination Spectra, by Jorge Sahade; chapter 13, Spectra of Long-Period Variables, by Paul W. Merrill; chapter 14, Physical Properties of the Red Giants, by Philip C. Keenan; chapter 17, The Spectra of Novae, by Dean B. McLaughlin; chapter 18, Spectra of Dwarf Variable Stars, by Alfred H. Joy; and chapter 19, Spectra of Stars below the Main Sequence, by Jesse L. Greenstein.

ANNE B. UNDERHILL

Galaxies (revised edition) by Harlow Shapley. Pages 186; 6×9½ in. Toronto, S. J. Reginald Saunders and Company Limited, 1961. Price $6.00.

This is a revised edition of a book which was first published in 1943 as part of the series of Harvard Books on Astronomy. The revised edition contains many new illustrations, which are of considerably higher quality than those which appeared in the original wartime edition. A number of minor revisions of the text have been made. The most important of these is the incorporation of a change of 1.5 magnitudes in the zero-point of the Cepheid period-luminosity relation and the resulting increase, by a factor of two, of the extragalactic distance scale. Such changes, important as they may be, do not reflect the revolutionary changes in our outlook,

which have taken place during the last two decades. In particular the revised edition does not reflect the impact which radio astronomy and theories of stellar evolution have had on extragalactic research.

On p. 131 the author obtains a distance of 3200 Mpc. for a galaxy of apparent magnitude $m = 23$ and an absolute magnitude $M = -19.5$. This calculation is incorrect since it does not take into account the large effect which the redshift has on the apparent brightness of distant galaxies. On p. 147 the absolute magnitude of the brightest cluster galaxies is given as $M = -19$. A value of $M = -22$ would appear to be more consistent with the currently accepted distance scale.

SIDNEY VAN DEN BERGH

Telescopes edited by Gerard P. Kuiper and Barbara M. Middlehurst. Volume 1, Stars and Stellar Systems. Pages 255; $7 \times 9\frac{3}{4}$ in. Chicago, University of Chicago Press, 1960. Price $8.50.

In this first volume of a nine volume series a rather full description is given of the principal instruments now used in astronomical and astrophysical research. The book covers four major topics: large reflecting telescopes (five chapters), position measuring telescopes (three chapters), atmospheric seeing (two chapters), and radio telescopes (two chapters). The discussion of specific examples is limited to those instruments, mostly in the United States, that are having the greatest influence on recent progress in this science.

Each chapter is an authoritative review article written by a leading astronomer. With the exception of the chapter on Schmidt cameras in which a brief analytical treatment is given of the aberrations of such systems, the text is descriptive and presupposes specialized knowledge at the graduate student level. Technical features of an instrument or group of instruments are described clearly and concisely and strong emphasis is laid on the physical principles involved in their design. Tables are provided which list the essential details of the major radio telescopes constructed up to 1960 and those optical telescopes with apertures over 20 inches (excluding solar telescopes). A generous supply of excellent plates, line drawings, and references to original papers contribute greatly to a generally pleasing format.

This book will have its greatest appeal among professional astronomers and scientists in allied fields who are unfamiliar with telescope design and who require a sound review of the necessary fundamentals.

V. GAIZAUSKAS

The Indian Ephemeris and Nautical Almanac for the Year 1962. Pages 460; $7\frac{1}{4} \times 10$ in. Calcutta, Government of India Press, 1961. Price Rs. 14.00 or 22 sh.

This Ephemeris, now in its fifth year of publication, contains information concerning the sun, moon and planets in nearly the same form as in other national ephemerides. In addition, however, are listed the geocentric longitudes and latitudes of these objects for the use of the Indian almanac-makers.

A section on the Indian Calendar is a unique feature of this Ephemeris: this is the Indian National Calendar, introduced in 1957. In this calendar the year ends on the day of the Vernal Equinox, with twelve months of 30 or 31 days. The tables extend to March 21, 1963, so that almanacs can be prepared for the complete Indian year. Gregorian dates are also included, as are the Christian festivals. This draws attention to the complicated calendar problem that still exists in India.

RUTH J. NORTHCOTT

An Introduction to Astrodynamics by R. M. L. Baker Jr., and M. W. Makemson. Pages 358 + xiv; $9 \times 5\frac{1}{2}$ in. Academic Press, 1960. Price $7.50.

This book neither is nor purports to be for the general reader. The authors assume a knowledge of the calculus and of vector notation, and have aimed to produce a text-book suitable for college classes at the undergraduate and early graduate level. It is their purpose to present, to engineering students with no astronomical training, the basic problems involved in the computation of the orbits of space probes. It does not seem to this reviewer that their purpose has been entirely achieved.

The astronomical content of the book is limited to a discussion of minor planets, of comets and of co-ordinate systems. These topics are discussed in the first part of the book, called "Fundamentals". The second half (More Detailed Analyses) is concerned primarily with the computation of perturbations in the orbits of space vehicles. The many forward references in the book suggest that a clearer discussion might have been achieved if the subject matter had been re-arranged. The problem of forward references has been aggravated by the provision of a glossary at the back of the book. This device, potentially useful in a subject which cuts across traditional boundaries, has been used as an excuse for omitting nearly all definitions from the text. Consequently, frequent reference must be made to the glossary and the reader's train of thought is broken.

It is the stated policy of the authors not to give derivations of many of their formulae. Even the two-body problem is not completely discussed. There may be good reasons for this policy, but its result is to produce many pages of equations between which there is no immediate logical connection. This is particularly true of the second half of the book, which can hardly be described as readable.

For students receiving a formal course in astrodynamics, this book will no doubt provide an adequate and useful summary of the ground covered. In this reviewer's opinion, however, it cannot be recommended to those who may wish to study the subject on their own, unless they possess a considerable knowledge of celestial mechanics.

ALAN H. BATTEN

Astronomy with an Opera Glass by Garrett P. Serviss, revised by Edwin E. Bridgen. Pages vi + 147; 6×9 in. New York-Montreal, Chatham Press, 1961. Price $3.95.

Astronomy with an Opera Glass first appeared in 1888 and has been out of print for some years. Now it has been revised by Edwin E. Bridgen, President of the Montreal Centre of our Society. The purpose of the author has been retained: to encourage people to discover for themselves some of the beauties of the heavens which can be seen with such simple optical equipment as opera glasses or binoculars. All of the objects referred to in the book were seen by the author with such an instrument.

The first four chapters describe the stars of the four seasons, and remain as originally written. The fifth chapter is concerned with the moon, planets and the sun; here changes have been made consistent with modern concepts. Throughout the book, numbers have been added in the margin referring to a section headed "Notes", which follows Chapter V. This has made it possible to draw attention to changes which have occurred since the first edition was written, and to give additional information of interest to the reader.

A number of errors in type-setting were noted. The most serious occurs in the "Notes" where, in two places, the use of a period instead of a comma may confuse the reader: the distance of the Hercules cluster is 34,000 light-years; light travels at 86,270 miles per second. Reference is made in the Table of Contents and on p. 139 to cuts which, in fact, are not included. However, the errors do not detract from the usefulness of the book. Using *Astronomy with an Opera Glass* and a good pair of binoculars amateur astronomers will find pleasure and some understanding of the universe.

RUTH J. NORTHCOTT

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